

Hemiptera

{hemi = half
{ptera = wings

28 p71 Box CM32

Heteroptera

{heteros = other
{ptera = wings

{Water bugs
{Land bugs

Water skater a type of the Hemiptera. It has three pair of legs, which are attached to the divisions of the thorax. It moves along with the back two pair, and uses the front pair for catching its prey. It has two pair of wings, which are not always present. They are used as a means of moving from one pond to another. It breathes in air, like the cockroach, through spiracles in the thorax. It only walks on the film of the water. It has a big beak; its food is chiefly composed of insects.



- Pond Skater -



- Water Boatman -

Rostrum + Setae {mandible & toothed maxilla

Homoptera

{homos = the same
{ptera = wings

{ex: Aphids
{Frog hoppers
{Parasitic lice

In the Spring the females produce a living insect,

^{imperfect} both male and females, and does thus, during the Summer, and these in their turn produce eggs. These again produce males and females. They live on the honey dew or sycamore trees, which they scatter about all over.

Fair

Orthoptera

{orthos = straight
{ptera = wings

Jumping
or
Musical

{Crickets
{Grasshoppers, long-horned
{Locusts & short horned grasshoppers.

Running

{Stick or leaf insects
{Nantidae
{Cockroaches
{Earwigs

Crickets

Found behind fireplaces, generally in old houses. The chirping noise that they make is produced by rubbing their strongly veined wing cases together. They have a nerve centre for hearing in the tibia of the fore-leg. They live mainly on plants, sugar etc.

Grass Hoppers.

Remarkable for their long legs which enable them to jump a long distance. They make a noise by rubbing their wings together. They feed on vegetables, grass etc.

Locusts.

They make a noise by rubbing the thigh against the wings, in the same way as the short-horned grass hoppers. They are very voracious, and migrate in large quantities.

Catwings.

They have a large wing, which is only used at night. They have a pair of forceps which differs in the male and female. It is used to hold what the catwing is going to eat. It is one of the few insects that watches over its young.

Mimicry.

Some insects have a very protective resemblance. The stick and leaf insects resemble very closely the sticks and leaves among which they live. In this way they are protected from other creatures who would be likely to eat them. and are unseen by creatures on which they feed.

Others are very brightly coloured, as a sign and warning to other creatures that they are noxious, and therefore not to be eaten. It sometimes happens that quite harmless animal creatures closely resemble others that are brightly coloured and noxious, and are taken for them by other creatures. Thus they live in security, seeming to be what they are not.

Good

Metamorphosis.

- June 5th -

Some insects change their food at different times of the year, when they change their appearance. They develop wings so that they may fly away to choose a suitable place with plenty of food, in which to deposit their eggs.

Neuroptera. nerve-winged.

The word comes from the Greek words neuron = nerve and ptera = wings.

This class of insects go through four stages, which are -

- egg,
- larva
- pupa
- imago, or winged insect.

The caddis worm lays its eggs on trees, or on stones by the water. The egg turns into the larva, which is made of sticks, stones, or very often small shells; many are always to be found under stones in water. When the insect gets to large for its case it builds on one end, and cuts off the end which is too small. It then weaves silk over each end. The insect now passes through a resting stage, when it is called a pupa. Then the perfect insect is formed, which has six wings. It feeds on vegetable food.

The oil Beetle is so called because it gives off a kind of oil which blisters. This insect has five stages in its life history. First it is an egg, which is dropped ~~on~~ the ground. After a little time it grows, and becomes a small orange creature, and then climbs up on to the top of some composite flower, waiting for a burrowing bee to come. When one does come it clings on its legs, and is carried off to its nest. When there, the first thing it does is to eat one of the bee's eggs, after which it moults. It moults several times, and then turns into a short legged, sluggish insect. Lastly it turns into a beetle.

very faint

Silver Fishes etc.	Oil-beetle - 12.	Cricket, Mayfly etc.	Many Carnivorous Beetles.	Higher Insects.
Campodea-larva, the only stage in the life-history.	Campodea-larva. Short-legged larva. Resting stage (pupa) to	Campodea-larva. Wings acquired gradually.	Campodea-larva. Resting stage (pupa) Wings revealed suddenly.	Short-legged larva. Resting stage (pupa) Wings revealed suddenly.

Coleoptera.

Beetles.

June 19th.

There are three thousand three hundred species found in Great Britain. The word "coleoptera" comes from "^{coleos} elutro" = sheath, and "^{rochos} kolos" meaning the same thing, therefore all beetles have sheathed wings, which are horny and hard.

^{They are called elytra from "elutro", a sheath.}
Dytiscus Marginalis or Little Bordered Diver is so called because it has a yellow border to its head wings and thorax, and because it dives. Its body is adapted for swimming by being of an oval, even shape. It also has small hairs attached to its back legs which broaden it out, so as to make them serve the same purpose as oars. The forelegs of the male

has a small sucker attached to it in the form of a daisy, by which it clutches to things, and catches hold of the female. It differs in form from the female by having this foreleg, and also the female has a ridged back, contrasted with its own smooth one. It breathes by means of spiracles which are to be found at the end of the thorax, under the wings. They breathe ^{oxygen} from the atmosphere, and not from the water. They feed on small fishes, tadpoles etc. Its mouth has two powerful jaws, which fold over and close over the mouth. They have a tube in these jaws which have the power of sucking the blood out of the insects and small animals it devours.

Life History.

The egg is dropped in the ^{stem of a water plant} grass where it lies until it is hatched, which is in about a fortnight's time. Then it passes into the larval stage, when it grows and moults several times, remaining on the ^{water} bank for about five or six weeks. Then it becomes a pupa, and stays buried in a hole ^{in the bank}, breathing in just as

much air as it can get from the ground, and it remains thus for about two weeks if it is in summer; but if in winter, sometimes it stays like that for the whole season. It then turns into a beetle.

Very few

Birds

Birds are specially adapted for their mode of living by several features in their form and limbs. They are vertebrate; their ^{bodies} wings are spindle shaped, to enable them in flight. They are adapted for perching by having four toes, three in front, and one behind. The reason why a bird does not fall off a perch when he is asleep, is that the muscles contract and the grip becomes firmer as the weight increases. The skeleton.

The head contains a very large space for the brain, compared to its size. The neck is very long, containing twenty ^{vertebrae} ~~carpal~~ bones, thus enabling the bird to easily obtain its food. The bones in the backbone are joined together, and the breastbone is joined ^{the shoulder blade} to it by the ^{coracoid} ~~quadrate~~. The coracoid is joined to the collar bone. The tail is often called the plough share, on account of its shape.

Books

Encyclopedia (Chambers)

Book of Nature Study Bk I.

Outdoor World (Furneaux)

Introduction to Nature Study (Stenhouse).

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For Feathers

Animal Sketches (Lloyd Morgan)
Round the Year. (Hall)
Study of Animal Life (Thomson)

October 9th.

Birds have a pair of lungs, supplied with many blood vessels. The air enters the lungs and passes straight through to the bones. They are also comparatively small, do not expand much, and are surrounded with air-sacks. Birds have a part of the stomach specially used for digestion, which has a very thick wall; the bird swallows stones in order to aid the process of digestion, by tearing the food. This part of the stomach is called the gizzard.

Feathers

A quill is the name for one of the feathers either in the wing or the tail of a bird.

The quill is, as it were, the stalk of the feather; the central vein is the shaft, and

The branches on either side of it are the barbs. These barbs branch again; the ^{barbules} ~~projections~~ on the upper side are hooked, the hooks being called barbicels. These hooks fasten themselves into the barbules below, which are grooved. Feathers which have a fluffy appearance owe it to the fact that they have no barbicels to keep the barbs flat.

Several kinds of feathers are found in a bird.

1. The quill is found in the wing and tail.
2. The contour feathers are those which cover the quills. Sometimes a small feather is seen attached to these, and is called the 3. after-shaft.
4. Down is found on small young birds, but it soon gives place to the feathers.
5. Filoplumes are those which are seen when a bird is plucked; they are long and narrow.

The feathers on the wing are arranged, some on the ~~top~~ hand bone (the primary), and the others, the secondary feathers, on the ulna. The feathers are arranged in coverts.

Good

Classification.

Birds can be classified in several ways: —

- I Carinatae
 Ratitae } Ostrich, Emu, Cassin's, etc.
 raft like }

II According to their habits: —

- Swimmers — Moor hen, coot, wild duck
 Waders — Flamingo, heron, stork.
 Birds of Prey — Eagle, owl, hawk.
 Scratchers — Pheasant, partridge
 Climbers — Wood pecker
 Peckers — Sparrow, thrush, chaffinch.

- III According to the length of their stay in the country:
 British Residents (126) Sparrow, starling, blackbird, lark
 Summer visitors (cir: 40) Martin, ~~lark~~, swallow.
 Winter " (60) Gulls, many sea birds.
 Occasional " (cir: 180) Shore lark, Alpine swift.

Wings.

The feathers on the wings of birds are arranged in two different ways. Some have a long ulna bone and short feathers as in the gannet while others have a short "hand" bone and long feathers as in the swallow.

Feet and Bills.

Birds have bills which are suited to their special manner of obtaining food. Those that catch insects are long and pointed ^(swallow) and those that get their food by heaving stones or fruit etc, are broad and blunt, such as the bullfinch. Their feet are suited to their manner of locomotion. The sparrow has three claws in front and one behind; the woodpecker and cuckoo, two in front and two behind; the swift four in front.

Eggs.

Gullenots = eagles
 Snipe's = cuckoo's partridges
 Larks = cuckoos

Birds.

In size gullenot = raven, but their eggs are 10-1
 In weight partridge = pigeon, but partridge's egg > pigeon's.
 " Snipe = blackbird, but its egg is much larger.

White eggs.

Barn owl	Dry neck	Dove
Dipper	Kingfisher	Swift
Woodpecker	House martin	Puffin

Page 1 is so very much better than page 2. The latter is probably hurried



Bullfinch - grain-feeder.



Swallow - fly-feeder.



- Linnet -



- Lark -

grain and insect feeders



(Climbing) Woodpecker.



(Perching) Missel-thrush.



(Bird of Prey) Eagle.



(Web-footed) Goose -



(Scratching) - Pheasant.



(Perching) - Lark.

excellent

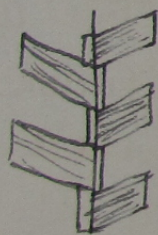
Architecture.

The characteristics of the Saxon period are the long and short work at the angles of the main walls and of the towers; the generally ^{rounded} ~~sometimes pointed~~ arches and doorways; and the large slabs of stone ^{under} on the arches, especially on those of the nave. The windows were always cut out of the walls, or out of one piece of stone.

The Church at Bradford-on-Avon is of Saxon origin; it has very few windows, and is divided into three.

The characteristics of Roman architecture are the flat red tiles placed in between the other stones to keep them together.

present day



Saxon



Long
and
short
work

Window
from
- Wicheham -



- Window - Deerhurst -

Very fair

Characteristics of Norman Period.

Plan- The apse is generally semi-circular, and there is always a nave and aisles.

The nave arcade has a triforium above it, and then the clerestory above that, in large churches.

Norman arches are ^{usually} ~~always~~ semi-circular, whether they are in the nave, windows or doors. The walls of the buildings are substantially made, as also are the pillars, which are very massive, and generally round. The capitals are cushioned ^{or} ~~and~~ scalloped, having a square abacus.

The towers are square and massive, and generally not very high.

The buttresses are not very big. ^{shallow all the way up}

Specimens of Norman architecture are to be found in many of our old parish Churches, and in most of the Cathedrals and Abbeys, such as:—

Canterbury
Rochester
Bury St. Edmunds (A)
St. Albans
Winchester
Ely

Hereford
 Gloucester
 Durham
 Norwich
 Tewkesbury (a)
 Exeter (b)
 Peterborough
 Rousay.

Very fair. No drawings.

Transitional Stage of Norman Architecture.

Characteristics.

1150-1200

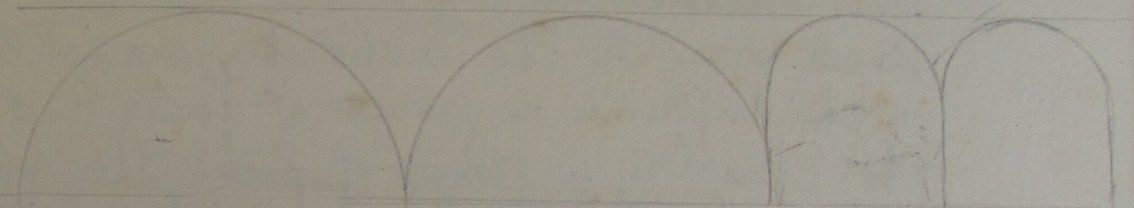
1. The arches are more ornamented.
2. The number of recesses is increased from about three in the earlier period, to five or seven.
3. The work as a whole is richer and more elaborate.

Examples

1. Caen Priory 1188
2. Furness Abbey. (part)
3. Some parts of Canterbury Cathedral, which were rebuilt in 1174 by William of Sens, and its resemblance to French architecture is clearly seen by the arches

which are narrow, and pointed, 2) the round apse is the same, 3) and the rich and elaborate arcading is the same.

Stilted Arches.



not sufficiently explained.

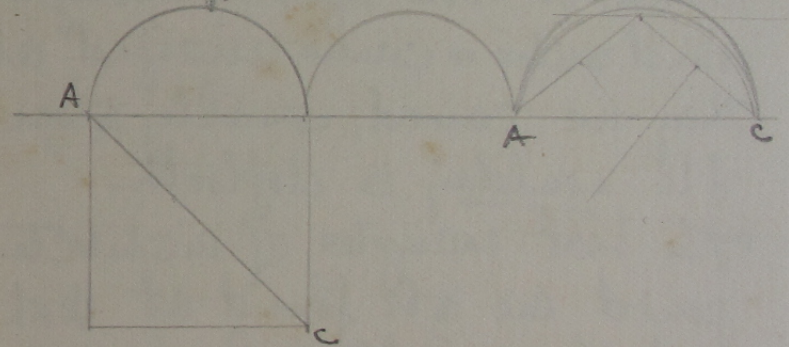


Diagram showing different methods of vaulting. The earliest vaulting is the barrel vaulting, which was built over the vaulting compartment. Then came the quadripartite vaulting; the ribs joined made a kind of X.



fairly good

Early English Period - 13th century.

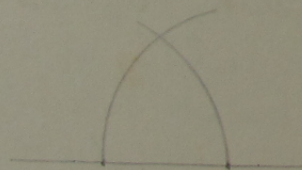
This period extended between the 1199-1290 roughly speaking. The Lancet period existed until 1245.

Characteristics.

The windows are long and narrow, with lancet tops. ^{at Hexham Abbey} In the aisles they are solitary, in the triforium in groups of fours, and in the clerestory in groups of fives. They vary in number, but they are grouped in this way in Hexham Abbey.

The capitals ^{have either a} are usually either square or a round, or both together, having square and round sides & corners arranged alternately. They are carved, usually to represent foliage. The moulding is dogtooth.

Good The best examples of architecture of this period are to be found at Hexham Abbey and Turo Cathedral.



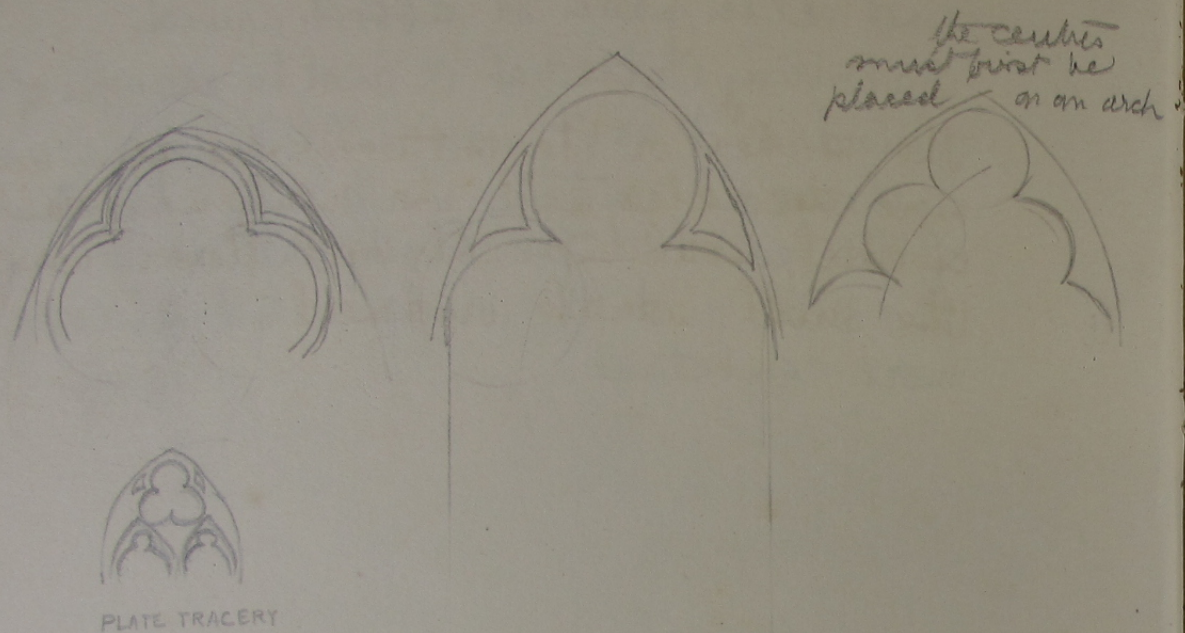
Example & diagram of the Lancet Arch.

Capitals are

The vaulting is usually six-ribbed, bell-shaped, and either plain or ribbed carved.

Salisbury Cathedral is another example of this period, and as it was built between 1220 and 1258, it contains work only characteristic of this period. The flying buttress is now to be seen, and the windows tend to become more equilateral.

Very fair

- Decorated Period -

This period extends between the years 1307 and 1377, and includes the geometrical and curvilinear periods. During this period the tendency was to make everything much more decorated, and the carvings were more elaborate. There was a great change in the windows. In the geometrical period they began to be made with plate tracery, and gradually they became more and more elaborately divided. The bays also became more ornamented. The clerestory windows tend to become longer. The vaulting differs in the number of ribs; although there were already seen to be so many, yet some more are added, as in the diagram.



New ribs added.

Good

The niches on the buttresses are very much more decorated, and the moulding is called 'crochet' moulding. The 'ball flower' was the most usual ornament.

- Perpendicular or Rectilinear Period -

This period lasted between the years 1377 and 1547, roughly speaking, and was influenced ^{in 16th cent.} to a large extent by the Renaissance.

The latter part is called the Tudor Period. The general characteristics of the period are: -

1. The towers are very beautiful.
2. The arches are broad and low; the ^{ogee} ~~selected~~ arch is often used, especially for canopies over tombs, and not so much for ~~have~~ arcading. which generally has 4 centred arches
3. Perpendicular lines strike the eye in almost every detail in the building.
4. The windows are high and broad; the perpendicular mullions go the whole way up. The tendency is to have as much light as possible, so the windows become larger, and the triforium is done away with. There is much perpendicular tracery, not only on the windows, but also on the walls, and on all flat spaces. The spandrel became decorated.
5. The doorways are generally enclosed in a square frame.
6. Many ribs have been added to the vaulting, and each rib is made symmetrical, so that the result is the beautiful fan vaulting.

Examples of work of this period is to be seen in: -

Canterbury Cathedral - Nave

Winchester "

Bath Abbey

Southwold Parish Church

King's College Oxford. Cambridge

Good

28 p95 Botsch 132

Geology
Biology

The Scenery and geology of the rocks
round Ambleside.

This district ranges from Ambleside as the centre, to Ilkewick, ^{spreading over} with a semi-circle drawn with that radius. This roughly gives the area of the district called the Volcanic Series of Borrowdale.

The scenery is composed of mountains which are typical of this kind of rock. It is of purely volcanic formation, and consists of layers of lava and ash.

Lava is the streams of molten rock poured out of the volcano at an eruption when the rock is ~~in~~ not ⁱⁿ such molten state, it is shot out in dust and when larger pieces are ejected, they ^{from a rock} are called breccia.

The spot that is considered to have been the volcano of this part is Castlehead, south of Ilkewick, which now is only 529 ft. high. When it was in a very active state, the small dust was thrown out

from the mouth of the crater to a considerable distance, while the bigger pieces being heavier, could not be thrown so far away.

In many places the rock consists of layers of lava, then ash, then lava etc. caused by eruptions at different periods.

eruptions

The outside is sometimes worn away by the action of glaciers, the weather etc, giving it the appearance of steps.

There cannot have been much action of water working, perhaps just a little on the lowest beds of ashes. ^{The fact that} Because there are no fossils in it, helps to prove that it was under air and not water, and that ^{or} noxious gases were given off.

noxious

The volcano that produced these mountains, was at least as large as *Etia*, which is 10840 ft. high.

The ^{one} product of volcanic ash is plumbago, from which the Cumberland lead pencils are made.

very fine

Creavage and Faults.

The earth's crust is quite cool and hard, while the centre is much hotter, and therefore is shrinking in the process of cooling. As the centre is contracting, the crust is cast into folds, and in some cases it breaks.

Slate is formed by soft rock formed of a mass of small particles, being subjected to great pressure; the long bits arrange themselves with their long axes at right angles to the pressure.

This ^{produces} ~~is called~~ cleavage, i.e. the rock can be split into layers. Some kinds of slate are finer than others, and in these cases, ~~the cleavage takes place in water~~

The volcanic series of Borrowdale is bounded by a band of Conistone Limestone; it is of a dark, bluish grey, it has fossils, not a large amount of lime, is very compact, and several layers are seen.

Sometimes in a stretch of rock, one part ~~being softer~~, slips below the level of the rest; this is called a fault. Sometimes the ^{displacement} ~~layer~~ is only a few feet in depth, but there is one 26000 ft. Fair

Skiddaw Slate.

June 21st.

The Dip of a stratum is the ^{angle at} direction in which it trends, it is not always the same angle. When the edge comes out at the top, it is called an Outcrop. Strike is the name of a direction of the outcrop. In flat country the outcrop and strike coincide.

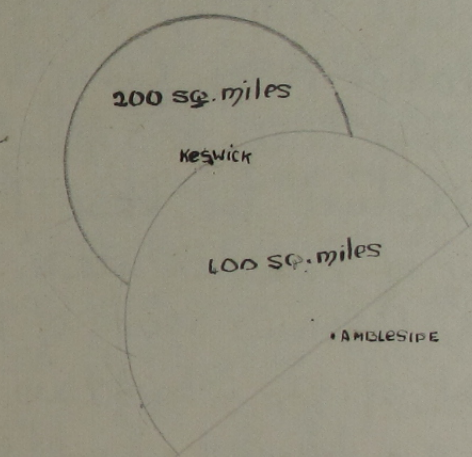
In this district beyond the region of volcanic ash, comes that of Skiddaw Slates; it is called Skiddaw slates, but good slates can rarely be ~~made~~ got, because the cleavage has not produced the same effect all over.

Skiddaw slate varies slightly in different parts, the different kinds are

1. inclined to be shaly,

2. breaks easily into flakes,
3. is sandy,
4. is gritty.

The region of the Skiddaw Slates can be seen by drawing a semi-circle from Ambleside with a radius of about ~~ten~~ 15 miles, and then drawing another with a radius of 10 miles from Kendal. Keswick



Scale
2 1/2 in. = 10 miles.

Fossils are found in this slate, and from them, and from the character of the soil, we can gather the following facts about the ^{past} ~~animals~~ ^{past} animals:

1. most have been the inhabitants of big rivers;
2. they must have lived in quiet places.

The characteristic fossil of the Skiddaw Slate

District is the graptolite.

When the volcano burst out, the principal opening was in this region, and it entirely covered the slate.

June 26th.

The manner in which the surface of the earth was formed

and consolidated
The geological formation of England can be seen from our district; it always consists of ^{successive} several sheets of rock, which always appear in the same relative order, though in some places, some may be absent. For instance, in this district we have the top layer consisting of ^{limestone} Poriston rock, the middle one of the volcanic Series of Bonodale, and the lowest of the Skiddaw Slates.

Rocks are formed by the means of two agencies,

a. water; then called stratified rocks,
example: - shale and limestone.

b. fire; called unstratified rocks,
example: - granite and lava.

Different kinds of rock are formed in

different ways; shale is mechanically formed, and limestone is organically formed, being composed of organic remains.

The name for the formation of this district is Lower Silurian, or, as it is now generally called, Ordovician.

The formation of different districts is sometimes named after the geographical name, the composition, or the number of layers.

One formation can be distinguished from another by the character of the fossils found, or by ^{its} unconformability. When one land surface has been disturbed before another has been formed on it, it naturally gets worn away in some places, and gaps appear; so when the new layer appears, it fills up the gaps, and then forms a new layer on the top.

The strike of the local beds of rock is the same as that of all England. *viz. N.E. & S.W.*

Do you ever read it through and notice whether it makes sense to the reader?

Neozoic
neos = new.

Paleozoic
= ancient.

Pozoic
eos = dawn.

Longmyndian
Daburian
Laurentian

Neozoic
neos = new

Paleozoic
palaios = ancient

Pozoic
eos = dawn.

Cainozoic

Mesozoic

Deuterozoic

Protozoic

Cretaceous
Jurassic
Triassic

Foraminifera
Ammonites
first mammal

Permian
Carboniferous
Old Red Sandst.
Devonian

reptiles
ammonites
cryptogams
fishes

Silurian
Ordovician
Cambrian

Graptolites
Trilobites

Ironidorian
Longmyndian
Dahurian
Laurentian

Oct. 4th.

The ^{relative} date of the laying down of the strata is ^{discovered} affected in four ways: —

1. The order of Superposition
2. Lithological character
3. Characteristic fossils
4. unconformability.

The names of the different formations vary according to the fossils which are found in them, and a great many derive their names from the country or towns which are situated near them. The Cambrian rock is found in Wales, and is composed of shale and mud consolidated into rock. There are a great number of forms of life to be found in it, the most common being the trilobite, which is related to the crabs. It does not usually produce grand scenery, except in a few cases, Harlech being one.

The Laurentian gets its name from the River St. Lawrence in Canada, the district lies round Hudson Bay.

The Longmyndian derives its name from a hill in Shropshire, Longmynd the scenery to be found is not very grand ~~or~~ but beautiful.

Good The Torridonian is composed of Old red sandstone.

October 11th.

In this district Sargeant Man is the centre from which the lakes radiate, and the rocks in that district are all stratified rocks, that is, they are deposited in layer after layer.

The rocks that are not stratified are called igneous, and are due to the action of fire. They are divided into two groups, — those which have cooled on the surface, and those which have cooled underneath the surface, called igneous Plutonic rocks.

It is often the case that one of the layers in the geological formation of a district is absent; in this district there is no old red sandstone. The most remarkable fossils to be found in it are those of fishes, all of them fresh water fishes. They differ from the

most common fish of the present time, in that they have fishy skeletons, rather than bony ones, and they have an uneven tail, due to the backbone being prolonged into one of the divisions.

In Devonshire, marine fossils are found in the old red sandstone. Another fossil found in the old red sandstone, ^{is} was that of a giant crustacean, six feet long.

In the old red sandstone period, there were great outbursts of volcanic action, and this is the reason for the beautiful scenery often found with it.

Above & below ~~the~~ the coal bearing strata two layers were found, the bottom one was called old red sandstone, and the upper one new red sandstone. Very fair.

The Carboniferous System.Oct. 25th.

The most characteristic and the most important system in England, is the Carboniferous system, which contains the ~~most~~ ^{coal measures} important layers, and comes on the top of the old red sandstone.

The name carboniferous means carbon-bearing rock, because it is full of vegetable remains.

This system is grouped into three layers; —

1. upper - composed of coal measures,
2. middle - " Millstone Grit.
3. lower - " Mountain Limestone.

Extent.

The Carboniferous system is to be found in the Black Country, the Lancashire and Yorkshire coalfields, along the Pennine Chain, in Northumberland, and in South Wales.

The purer the limestone is, the deeper

the sea is supposed to have been.

It is the purest when found nearest the west; towards the east it becomes sandy beds, which shows that the east was the shore.

It is largely composed of organic remains, in some places it is entirely made up of fossils, the most characteristic being the stone bligs or encrinurites.

The Mountain Limestone is often carved out in beautiful caves and pinnacles.

The Millstone Grit is found in the moorland ^{parts} (scenery) of Yorkshire. It was deposited on the top of the limestone, and the coal measures on the top of that.

Anthracite

^{coal} Anthracite was laid down the deepest? and for the greatest number of years; it is used only in closed stoves, as it burns so slowly.

Cannel is the least changed, and has therefore had the slightest pressure.

The best sorts of coal fell where they grew, but the inferior sorts are supposed to have been full of water, and floated about

found in South Africa.

The Triassic formation is formed of the second kind of red rocks, and consist of three beds, which are all to be seen in Germany, and are named in German.

The lowest is the Bunter; the middle the Muschelkalk, which is a limestone full of organic remains, and the upper the Keuper. The Bunter and the Keuper are to be seen in England, but the Muschelkalk does not occur.

Muschelkalk

The Bunter extends from the mouth of the Tees, through the middle of England, to the Bristol Channel, and the mouth of the Exe. One branch goes up by Lancashire. It is best developed in Cheshire, where it contains salt.

Marl is a compound of clay and lime, ^{in this age} and is used for making Plaster of Paris; it is formed out of beds of shells. One of the fossils found in it are called microbites, which are the oldest known mammals.

contains layers of gypsum

and is

Many of the chief water supplies are obtained from the Bunter and the Keuper layers, ^{formerly} those of Birmingham, Liverpool, Nottingham and Manchester.

Very Fair

The Jurassic Formation.

This formation is very well developed in the Jura Mountains, hence its name.

In England it is very widely spread over the country from Lyme Regis to Whitby. It is divided into two groups, the

1. Lias
2. Volite.

The name "Lias" comes from a corruption of the word "layers". It is chiefly composed of shales, with some limestone layers.

Above, is the Volite formation which is a composition of grains of limestone, which have collected in ^{grains} ~~enclaves~~ somewhat

resembling the ^{roe} of a fish.

The ^{oolitic} ~~massic~~ formation is usually in two layers with a layer of clay in between to divide them.

The characteristic fossil of this formation is the Ammonite, which ^{is} ~~are~~ found in great quantities, and the different strata can be distinguished by the different species.

The Lias can be again sub-divided into eleven different groups, and the Colite into three.

It is quite certain that the formation must have been laid down in a warm sea, because of the presence of the ammonites.

The most important products are Portland Stone, Bath Stone, cement which is made from the stone, and Purbeck marble.

The appearance of the earth above ground was a great number of coniferous trees and ferns.

Very fair

The Pleistocene or Glacial Period Nov: 29

The word "pleistocene" is derived from the Greek "pleistos" = most, and "kainos" = recent.

The fossils found are more similar to those of the present day, than any found in other periods. The ice moved across the country leaving behind it large deposits; these Pleistocene deposits are to be seen as far south as the valley of the Thames.

In the first place they were supposed to have been due to the Flood, and the name given was "diluvian". Then they were termed "glacial", because they were thought to have been moved by ice. This "glacial" is sometimes composed of "till" and sometimes, and more often "boulder clay".

Proofs of the glacial period in the Lake District.

As the glacier moves along, it polishes and wears away the ground underneath and at the sides. Moraines are also formed at the sides of the glacier beds, and they can be recognized in countries where there are no glaciers remaining.

very
expressed

Underneath the glacier there may be what is called a ground moraine.

Glaciers not only polish and wear away the rock underneath, but they break it up into large boulders, and also leave it scratched. The rocks that are thus passed, and left scratched and rounded, are called "roches moutonnées".

It is a common error to think that ice always carves valleys out, it scoops them out so that the tributaries flow in at a high level. These valleys are termed hanging valleys.

In this district scratches are found on the rocks on the Brathay Moors, the old road to Gasmere, and at Skelwith Fold. In many places the scratches look as if they had been made on quite soft rock.

Almost every valley has beds of boulder clay. Sometimes large blocks of stone are found on the top of mountains etc, and are composed of entirely different rock to that found in the neighbourhood. These must undoubtedly have been carried along on

the surface by glaciers, and left where they now stand. They are called "blocs perchés".

V.9. 20/Jan

The Glacial Period (continued.)

The former history of the lake district.

The land ^{is} was supposed to be ^{have} higher, and the cold greater than it is in the present time; the glaciers brought with them deposits, — moraines and boulder clay. The cold then decreased, the land sank below the sea level,

to 1,500 ft the sea swept the beds of clay, leaving mounds of sand and gravel called eskers, rarely containing large boulders. The land then sank ²⁰⁰⁰ 1600 ft. below the sea level, and the cold returned again, the land being capped with ice.

very fair so far

Biology.

Jan: 21st.

Biology is the study of life, which includes many different subjects, such as botany, natural history, physiology and geology, through which we ^{can} study the different forms of life.

The ^{earliest} lowest forms of life found ^{on land} in water are the Amphibians, and in vegetation, the Algae; closely connected with them are mosses and liverworts, which live in damp places. All these forms of life, which are the lowest now, were the earliest. ~~then~~

The shore is the battle field, so to speak, where the different forms of life of the air, land, and water all meet.

There are six haunts of life:—

1. Shore.
2. Open sea. Swift swimmers are found, jelly-fish, cuttle fish, and many small

crustaceans. The Neclon is the name given to the creatures moving about, and the Plankton, to those merely drifting along.

The pelagic, or free-swimming animals are quite independent of the earth, and form the food supply of many fishes.

3. Deep Sea. There is no depth limit to it, and the pressure is enormous, being as much as 2 1/2 tons to the sq. inch. The water is quite calm, there are no plants, and the animals feed on one another.

4. Fresh Water. The number of species found are comparatively small.

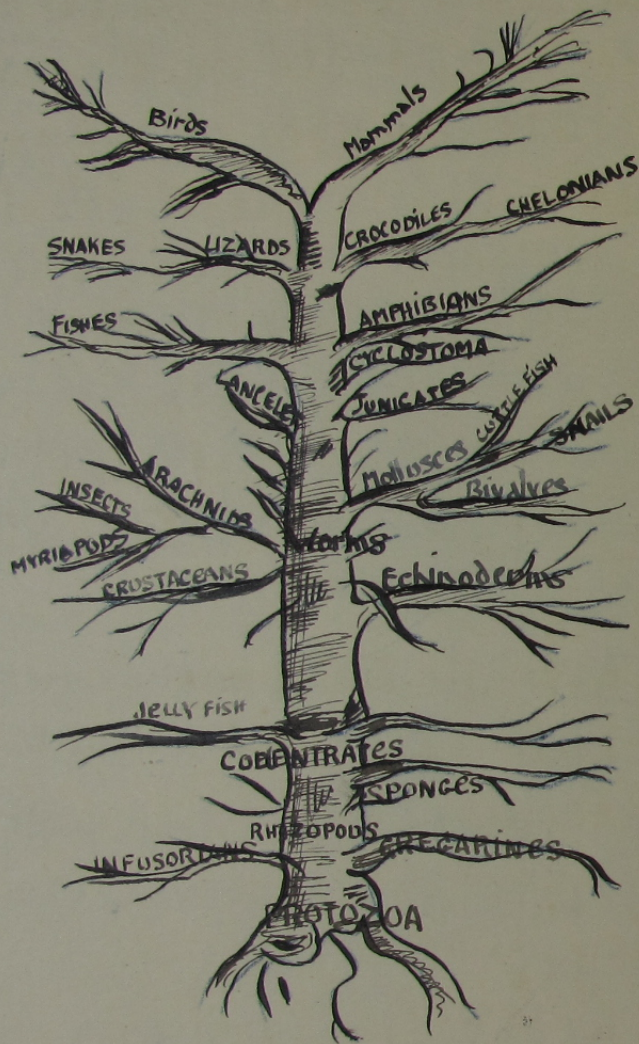
5. The Earth. The earth worm was the first animal that lived on the earth.

6. The Air. To the air belong most insects, birds and bats, and a certain lizard, that can swoop from tree to tree.

Three means of classification.

1. By evolution
2. By geology
3. By comparing with other animals the development of the individual.

Very fair



- RHIZOPODS -

Jan: 28.

I Rhizopods are a sub-division of the Protozoa; the word comes from the Latin ^{Greek} rhiza - a root, and the Greek pous, podos, a foot. The amoeba is one example of this species; it is a very small one-celled animal, each one being composed of protoplasm, and looking like a tiny drop of slime. They live on, or just under the surface of ponds, and there is one species that lives on dry land. Although they are only one-celled, and have no special part of their body for respiration, yet they have the same impulses as other animals, they move, feed, grow, and are aware of danger just the same.

When they move, they send out one of their feet, in which they draw the rest of their body, and then spread it out again.

They are most wonderful little animals, being so small, that they are rarely seen with the naked eye, and being only one-celled, and yet having the same powers

as other more highly organised animals.
 They were first discovered by Rösel von
 Rosenhof in 1755.

Infusorians

II The Infusorians are another sub-division of the Protozoa. ~~There are~~ three types are monads, noctiluca, vorticella. They are slightly more highly organised than the amoeba, having a small mouth, and a cilium, used for sending water into their mouth, and as a means of moving about.

Noctiluca = phosphorescent bodies.

Vorticella = bell-shaped, one-celled, live in groups.

Monads = one-celled

III ^aGregarines, encysted, wholly parasitic, one-celled, passive.

Three physiological possibilities of ^{cells} Rhizopods.

- Active, medium, passive.
- All cells, both animal and vegetable, are thus:

passive	{	fat-cells	amoeboid	{	ciliated.
		mature ova	white corpuscles		sperm cells
		germ cells	young ova		
		degenerate muscle			
- Protonyxa = name given to one-celled animals which are so simple that they change their form from one stage to another.

Colonial Protozoa formed by

- Incomplete Division.
- Conjugation.
 - Cell divides into ^{parts} divisions, which are not separate.
 - A number of cells forming a plasmodium e.g. "flowers of tan".

very fair

The Hydra.

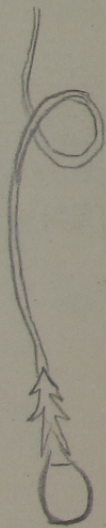
Feb: 25th.

Hollow bodied, having two layers, lives on ~~pond~~ weeds to which it attaches itself. Lives on other animals often larger than itself, which it catches by means of tentacles. Called "Passa-thrower" because of stings which is ejected from tentacles when touched, ^{in form of} by means of threads, which are curled up ^{each} inside animal. a cell

Reproduced by means of branching; young animal separates when large enough.



-Thread retracted-



-Thread protruded-

-Stinging Cells of a Coelenterate-Hydroid Colonies.

- Colonies of hydroids living together, and joined by a fine thread. Sometimes in the form of plants, therefore called Zoophytes.
- I The Hydractinia have four different individuals, reproductive, nutritive, sensitive, & protecting.
 - II Campanulina - hydroid colony having cells which branch giving appearance of a plant. When cells free to be liberated, fall off, and float on water, and produce eggs. Cells bell-shaped; called Medusoids. Eggs produce stock again, = "alternation of generations".



-Campanulina-

Fairly good

Coral.

March 11th.

Red Coral.

Lump of jelly-like substance ^{falls} from the mouth of the polyp, to the bottom of the sea. As it falls it attracts carbonate of lime, and from it spicules are formed everywhere in its body, except in its stomach. The new buds are white and 8 rayed. The red coral is the central part, which remains after the rest is dead.

Organ pipe coral.

The polyps are 8 rayed, and arranged in tubes, which are joined by little platforms.

Dead Men's Fingers.

Formed of a jelly substance - 8 rayed.

Reef-building Coral.

The polyps are constructed like sea-anemones. Live close together in large quantities, in warm temperature. Growth not very rapid. Best specimens found off Fiji Islands.

Starbuilding coral, so called from shape of polyp. Warm temperature.

Brain Coral, so called because of its resemblance to the convolutions of the brain. Warm temperature.

Madrepore grow very quickly.

Worms.

Worms is the name given to soft-bodied invertebrate bilaterally symmetrical animals, which do not possess the chief characteristics of any class. They are bilaterally symmetrical because they burrow, making the pressure on either side equal.

I. Flat worms.Example Fluke.

The Fluke is a parasite that is found first of all in the intestines of a water bird; its mode of reproduction is very wonderful. The mother drops the eggs which fall into the water, one of them becoming a creature covered with lashes. They produce little creatures covered with an ~~an~~ ^{an} ~~larva~~ ^{larva}, resembling tadpoles, which have to find a snail to which they attach

themselves. They bore a hole, and live inside the snail, until it is eaten by a waterbird, becoming mature flukes again.

Tape-worms. They have a similar life-history to the fluke, that of the mouse is reproduced in the cat, and the same happens in other animals.

II Ribbon Worms - Hemertians - marine animals; have ciliated pits ^{resembling} corresponding to the gills of higher animals. On its back it has a proboscis enclosed in a sheath.

III Round Worms - Trichina, Thread worm.

- Starfish -

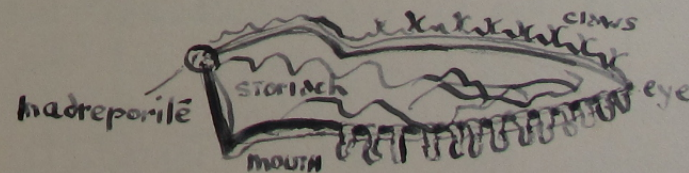
Five-rayed, having an eye at the end of each ray, some species having an lid.

It has a small mouth underneath, and feeds on small creatures, principally shell fish, which it eats, leaving the shell.

In the middle of its body it has a tube called the "madreporite" ^{by canal} going right through the body from the ^{near top} under side to the upper. At the top of this there is a small plate of perforated lime called the "madreporite".

It has a water vascular system, and tube feet. The starfish moves along by means of these numerous feet, which act as suckers when some of the water inside them is withdrawn.

By means of these suckers, it is able to turn over. The skin is prickly, and very leathery, composed of carbonate of lime. For this reason the sea-urchin is easily



carbonate

crystallized. Spicules (if any) are composed of carbonate of lime.

Animals belonging to the class Echinodermata:

Crinoids a stone lilies
 Brittle stars, body in centre, 10 arms wh. can part with in danger.
 Starfishes
 Sea urchins
 Sea cucumbers.

All these animals, without exception are marine; have radial symmetry in adult; larval forms, bilaterally symmetrical.

Fossils called "ecrinurites".
 encrinurites

Sea Urchin.

The sea urchin is generally found underneath rock; it also burrows in lime, and many fossils are found there. It is closely allied to the starfish, but differs in appearance because it has been adapted to its life. The five rays of the starfish have been turned up so as to almost meet at the top, leaving the mouth at the bottom. As there is an eye at the end of each ray, there are five at the top. The tubes run up the sides. The spines are used for protection. It has snapping jaws which serve to pass out refuse through the hole at

Good
 April 29th

✓ the top.

Fresh Water Mussel.

May 6th.

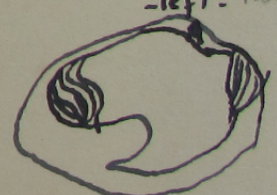
Has two shells hinged by a ligament, enclosing a soft body. It is closed by two adductor muscles. The mantle is an organ which covers the soft body of the fish on all sides; its functions are:— To increase the size of the shell according to the growth of the fish, and to build it up when it gets damaged. It gives the shell its colour, which is always that of the mantle. It has a comparatively large foot, which it sticks out, and fixes in the ground, thus pulling the shell after it. It has no head. The mouth is not far from the hinge. It breathes by gills; the water is brought to them by means of ^{inhalant} interior and ^{exhalant} exterior siphons. Its enemies are starfish, which settle on the shell, thus preventing the creature from opening it.



-Scallop-



right valve



-left. valve of a Mya or Baster

-Cyprina islandica-

Good

- Cephalopods -- May 20th -

Kephale = a head -

pous, podos = a foot.

1. Octopus - type of one of the groups of cephalopods. Very high form of life compared with other invertebrates. They have a very characteristic power of squirting sepia and water. The water is taken in at a little hole where the mantle does not quite meet, and is squirted out by a siphon at the back of its head. It has eight arms, which are very powerful; they come from near the head. It has a wonderful power of changing colour, thus adapting itself to its surroundings.
2. Cuttle, Squid, Calamary etc. - These are able to form a kind of shell under the skin.
3. Nautilus - It has a beautiful shell, four breathing gills instead of two as in the Octopus, but has no suckers. Its eyes are not very perfect.

- Mollusca -

Sammelibranchiata or Plate gilled { headless & bivalve

Siphonida

Siphonida: Boreis, Gapers, Razors etc.
Naccha, Venus, Cyprina, Cockles.

Asiphonida: Mussels, Oysters & Scallops

Cephalopoda - heads, univalve

Pteropods or sea butterflies.

Gastropods.

Order I.

" II (a) Indibranchs, sea slugs & sea lemons
(b) ex: Bulla

Pulmonifera: slugs and snails.

Prosobranchiata - }

Entire aperture Clinton

Tooth shells

Limpets

Ear shells

etc.

Notched margin

Carnivorous

eg. Cowries, limpets

Whelks, Muricea.

Good

Prawn

Crustaceans

The prawn has a jointed armour of chitin. Its body is divided into two segments, one consists of the head, and the other of the thorax and tail. The cephalothorax has as many joints as appendages, which are: —

- 1 pr. mandibles
- 2 pr. maxillae
- 3 pr. maxillipedes
- 5 pr. legs — one clawed

on cephalothorax

- 5 pr. swimmerets
- tail.

on abdomen

The ^{abdomen} ~~thorax~~ consists of five pair of swimmerets and the tail; there is a joint at each pair.

The prawn grows by shedding its shell.

It moves by means of its swimmerets; it uses its ^{"foot-jaws"} feet for eating, and for walking, there are seven 3 pairs. The mandibles are used for eating, they are very strong indeed. It lives chiefly on shrimps and other small fish. On the top of its head it has a sharp toothed saw.

A shrimp has eyes, out of which it can see in all directions. It also has ears which are at the base of the antennules.

gain

June 9th

Egg	Egg	Egg	Egg
	-	zoea	nauplius
	Myasis	Megalopa	zoea
Cray fish	Lobster	Crab	Myasis
			Penaeus or
			Opseus shrimp

Crab. When it comes out of the egg it has a very soft shell, and a long tail — this is the zoea stage. It then sinks to the bottom of the sea, and moults several times, and then turns into a walking crab.

The back or cephalopod of the crab corresponds to the head and thorax of the prawn; it also resembles it in having nineteen pairs of appendages. The crab leaves out one of the stages in the development of most of the crustaceans.

Disconnected.
unfinished?

June 24th.

Butterflies, & insects
These creatures high up in life, such as the ~~vertebrates~~, have a very high development especially in the nervous system.

The backbone of the vertebrates is part of the internal structure of the skeleton.

All forms of life have risen from a simple form, from the worm for example, and each class branch has developed in its own special manner.

The Invertebrates are small, mostly silent, and devoid of all facial expression; they do not live to see their children.

Characteristics of the Vertebrates.

1. Spinal Cord & Brain.

The backbone is the characteristic feature of the vertebrates; its use is, to protect the spinal cord and the brain.

2. Notochord.

The notochord is a strong, white cord stretching from one end of the body to the other. In the lower orders it takes the place of the backbone, but in the higher, it is only found in the embryo stages, afterwards being suppressed by the backbone, when all that is left of it, is pads of cartilage between the vertebrae.

3. Gill Slits.

Gill slits are found in birds, reptiles, fishes, and in the human body the ears are said to be derived from them. Fish use them instead of lungs for breathing.

All vertebrates have bilateral symmetry, and a segmented backbone.

The Lancelet, a creature found on the shores of the

Mediterranean has a notochord throughout life, it never loses it for a backbone. It is a fishlike form, but cannot be called a fish because it has no fins, no jaws and no skull.

The Tunicate lives on rocks below high water mark, and it has no backbone. It is interesting because it takes in oxygen which from the water, which it draws in through a small kind of tube, and then squirts it out through another one, thus giving it the name of sea-squirt. Its food is drawn in with the water, and is filtered through a net. It is found in most seas.

The Langrey is characteristic of the "round-mouths"; there are marine as well as river langreys. They have no jaws, and no limbs, and their backbone is justly having at the end a justly skull. Their mouths are round, having rasping teeth arranged in a circle, in the centre of which is a tongue, used for sucking the juices out of the fish on which they settle. They breathe through seven small

holes on either side of the head, each of which has a small bag attached. These are joined by a tube which conducts water from the mouth if required.

For the first three years they live a very sluggish and sedentary life, but at the end of that time they become quite animated, and swim rapidly about with bright eyes. They grow sometimes to a length of three feet.

Fishes.

Chief characteristics. Fishes are adapted to their mode of living by their boat-shaped, smooth and slippery bodies. They also swim by means of fins, of which there are two pectoral and two pelvic. The latter take the place of limbs. The fins on the back are used for steadying the fish. A fish is half composed of muscles, and the other half contains the organs. Fishes breathe by means of gills; the water passes over the gills, the oxygen being passed into the blood, and then the water is sent out through the gill slits. Fishes have an air bladder, which in most cases is ^{accommodates itself} used to regulate the depth of water in which they live. In some fish however, in the Dipnoi, for example, the air-bladder is used as a lung, for breathing; the reason being that when as they live in mud they cannot get any air water when the mud gets too dry, so they have to come to the surface to get more.

1. Elasmobranchs -
a gristly fish Sharks, dog-fish, skates, rays
sawfish etc.
Silurian.
2. Ganoids -
a enamel-plated fish Seven living genera eg: sturgeon,
honey pike
Devonian and Carboniferous.
3. Dipnoi -
a double breather. Three living genera.
Australia & tropical Africa.
Permian.
4. Teleosteans
a bony fish. Majority of living fishes
including eel like forms.
Chalk.

Ray or Skate.

Flattened from the top.
Eye on dorsal surface,
mouth on ventral.
Swims about.

Plaice or Sole.

Flattened sideways.
Eye first on left side, moves
over to right.
Lies in mud on left side.

Good

Amphibians.

{Amphi = with
{Bios = life

British Specimens.

Frogs	Newts	Toads
2	3	2.

Amphibians ^{were} ~~are~~ known to exist in the coal age as we find their foot prints in coal mines, and also their fossils. They were very much larger in those days, some being as much as ten feet long. In shape they were like newts, only of course much larger, and they used to crawl about in the soft mud, some very slowly, but those with thin scale like ^{scaly} bodies were much more active.

Frog.

The difference between frogs and fishes is that a frog has a three-chambered ~~chambered~~ heart while the fish has only two; a frog has lungs, and also breathes in through its very thin, naked skin; a frog's limbs are jointed. The frog is cold-blooded, and can live either on the land or

in the water. It has the power of changing the colour of its skin, this being partly due to the effect of temperature and surroundings. In the heart the pure and impure blood is mixed in the ventricle, and in the mouth the pure and impure air are mixed. The nostrils are used for breathing. The frog has vocal cords, and consequently is known to sing, or croak.

Tadpole.

The tadpole goes through many changes before it becomes a full-grown frog. In the first place the spawn is like with the eggs inside; they are black on the upper, and white on the lower side. Then it is like a round dark in formation, breathing in through the tufted gills. It becomes like a lamprey when the jaws are forming; until now it is a vegetarian, but it now becomes carnivorous. In its next stage it resembles a fish, breathing in by gills, and using its tail for swimming. Lastly it becomes an amphibian, and is known as a frog.

Reptiles.

Chelonians { tortoises
turtles

3 snakes

2 lizards & 1 slow worm
crocodiles.

All reptiles are known by the three chambered heart (except the crocodile) scaly skin, and by their breathing by means of gills. The crocodile is the only member of the class that has teeth fixed in sockets. Reptiles shed their skin every year, and in the skin the eyelid may be seen.

How to distinguish a ^{British grass} snake from an adder.

Snake.

1. Generally found near water, or amongst dry leaves. (day)

2. Generally green, or dull grey, with black spots.

3. Movable neck.

4. No special mark on the head.

Adder.

1. Found on dry, warm sandy banks.

2. Markings on the back in the form of a zig zag.

3. Constricted neck.

4. Maltese Cross on the head.

The adder moves by means of scales on its under side, which are moved by means of the ribs, a pair being fixed to each scale.

In an adder of about eighteen inches long, there are about 150 pairs of ribs.

Their upper jaws are very loosely fixed, and move in the opposite way to which ours do - outwards - thus enabling the

adder to swallow animals and insects? which would appear to be too large for its mouth. Between the jaws there is a small space for the tongue to come through. The teeth are able to lie quite flat in the mouth.

Grass snakes have a comparatively long bone to which the teeth are attached. In the adder this bone is shortened, and to it is attached a fang, to which poison is sent from the poison gland. Should the tooth containing the gland be broken, there are other fangs ready to supply the poison.

Good

Lizards -

There are two species -

- i Common lizard - *Lacerta vivipara*
- ii sand lizard - *Lacerta agilis*.

The common lizard is the one most usually found, and it is remarkable for its beautiful markings. The sand lizard is found in the South of England; it lays its eggs in the sand during May or June. Lizards generally like warm, dry places, but sometimes they live in moist parts. They differ from newts in that their eggs are not laid in the water, and they never live in water. Also their skin is scaly, while the newt's is soft, and it has sharp claws, which the newt has not. They live on insects.

The slow worm is grey or black, scaly, and has a shiny surface. It gets its name *anguis fragilis*, because its ^{body} skin is so fragile and breaks so easily. It sheds this skin like a snake does.

The tortoise is well protected by having a hard bony covering, which is formed of the ribs consolidating into a solid surface. It is sluggish, and very tenacious. Its chest cannot expand, thus it breathes in air like a frog. It lives on dry land, but there is one kind that lives in rivers.

The crocodile has a four-chambered heart, and teeth in sockets, so it is a higher form of life than lizards and slow worms, which have only a three-chambered heart. They are very ferocious and cruel animals.

The reptiles and birds that we have at the present day, had the same ancestors as mammals. These ancestors were animals of gigantic size, some of them being as much as a hundred feet.

The Archaeopteryx, or flying reptile, had a long jointed tail, with a pair of feathers attached to each joint.

Extinct Reptiles.

Having affinities with
lizards & crocodiles.

Dinosaurus
deinos = terrible

ex { Iguanodon
Megalosaurus
megale = great
Archaeopteryx

Ichthyosaurus
ichthus = fish

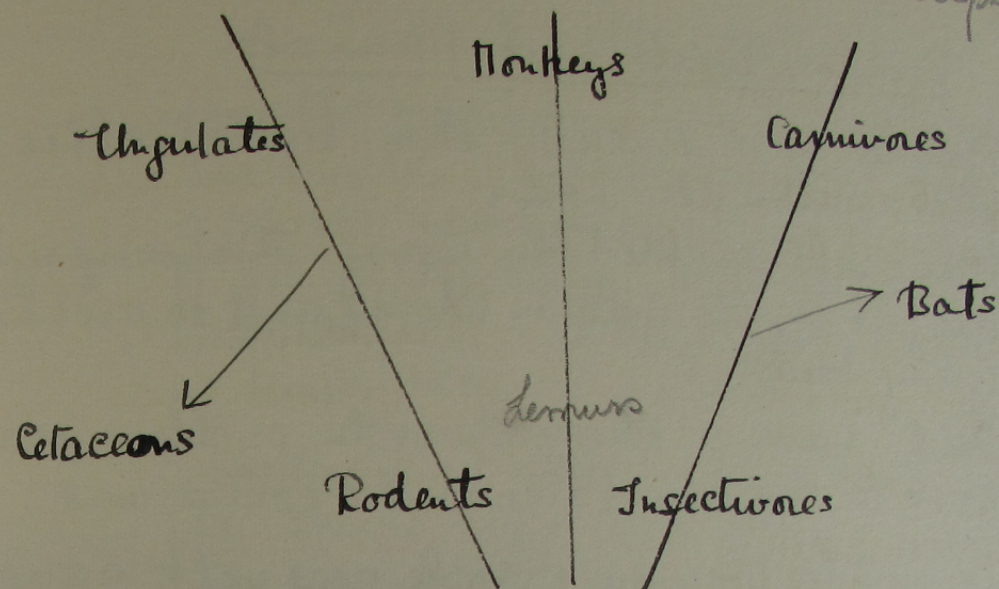
Pterosaurs

ex { Pterodactyl
Dimorphodon

V. 8.

Having affinities with
turtles.

Plesiosaurus
plesios = near
and perhaps
mammals.



Edentata

Marsupials

Primitive mammals.

Reptiles, Birds and Mammals.

- Hair- Reptiles have a scaly skin, Birds feathers, and mammals hair.
- Milk- Mammals suckle their young. The young reptiles are fed by the yolk in the egg, and so are the young birds.
- Bones- Birds have a strong shoulder girdle; mammals have a shoulder blade and a collar bone.
- Teeth- In reptiles they are conical pegs with a single fang. In birds they are absent. In mammals they are cusped, and those at the sides have two fangs.
- Ear- The cochlea is absent in Reptiles. In birds it is ^{absent} representative is to be found joining the jaw to the skull.
- Temperature- That of birds is the highest. Reptiles are cold-blooded.
- Jaw Bones- In mammals the jaw-bone is in one piece; in birds it is formed of two bones.

Primitive Mammals.

1. Ornithorhynchus = Duck-billed Platypus or Duckmole. This is about the size of a small rabbit, and has an outer covering of fur, resembling that of a mole. It has webbed feet. It lays two eggs which are no larger than a robin's.
2. Echidna ^{porcupine} ~~anteater~~ - This animal is about the same size; has claws, and is prickly.

Marsupials.

They are extinct in all parts of the World except in Australia and in the forests of America. They are pouched animals, and they include all the different kinds of feeders.

For example:—

- carnivorous - Tasmanian Devil
- herbivorous - kangaroo
- insectivorous - banded anteater
- gnawing - wombats.

The most well-known are the kangaroo and the opossum.

The kangaroo lives in Australia, and uses its pouch to carry its young long distances.

in search of food and water. The young ones can hop in and out of it at will. The opossum lives in America; it is omnivorous.

Edentata.

The representatives are the: —

1. sloth
2. ant-bear
3. armadillo
4. anteater
- 5 pangolin

All members of this class are toothless, or very nearly so. The ancestors of those we have to-day were very much larger. The sloth, antbear and armadillo are to be found in America, while the anteater and pangolin are only to be seen in South America.

Sirenia.

They are vegetable eaters. Two representatives are the manatee and the dugong.

1. The manatee, or sea cow, is to be found round the coasts of Africa and ~~Asia~~ South America. They are about 8 ft. in length, and their rounded bodies taper into a flat tail.
2. The Australian dugong is much sought after on account of its oil. It has plates in its mouth which serve instead of teeth.

Good